

MARYLAND BETA CHAPTER

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VOLCANOES AND THEIR ERUPTIONS

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## VOLCANOES AND THEIR ERUPTIONS

One of the more interesting studies of the geological structure of the earth is the phenomenon that is connected with the movements of molten rock matter and its subsequent formation into igneous rock. Within the earth's core the high temperature is sufficiently great to melt solid rocks. This molten matter, dissolving and fusing its way, rises toward the surface along fissures and fractured zones which were probably formed during the periods of mountain growth.

The opening in the earth's surface through which these hot rocks are forced out is called a volcano. The word being derived from Vulcanus, the Roman god of fire, who was supposed to dwell in the volcano Mount Etna in Sicily. When solid rock fragments or lavas, which are rocks in a fluid state, accumulate around the opening, a cone is built up which increases in size. A cone so constructed is called a volcano. This formation is only a result rather than a part of the phenomena of volcanic movement. At the top of the cone there is generally a crater that is usually funnel shaped and represents the vent through which the volcanic matter is ejected, widened near the top by explosions. (Fig. 1) The slope of the cone usually is as steep as the erupted material will lie. If the eruptions consist of ash and large solid fragments, the cone will have steep walls. The volcanoes that throw out this type of matter are of the explosive type and generally eject gases in considerable amounts.



If the eruptions consist of flowing lavas, the volcano will have gentler slopes. These volcanoes throw out little solid matter. Gases are generally present, however, but they do not accumulate under pressure, thereby escaping quietly.



A view into the crater of Vesuvius.

Volcanoes vary in size from the small conical hills to some of the loftiest mountains on the earth's surface. The Hawaiian Islands contain the greatest volcanic mountains in the world, rising nearly 14,000 feet above sea level, and 30,000 feet above the sea floor.

The eruption of a volcano often is accompanied by earthquakes and by loud rumblings, like thunder. The rumblings probably are due to the movement of gases and lavas that are held in under great pressure. During eruptions the condensation of the steam causes heavy rains accompanied by vivid lightning. The rain often washes vast quantities of loose ash down the steep slopes in destructive mud flows. Preceding the eruptions fissures often are opened. Hot springs appear at places, and flowing



springs are dried up. Cracks open, and gases issue from them.

The materials erupted from volcanoes include solids, liquids, and gases. If the eruption is moderate, melted rock usually flows out, and in cooling, forms lava flows. (Fig. 2)



Lava flows.

In violent eruptions the expansion of the steam blows the lava to pieces, forming scoria, pumice, and ash. These are so light and porous that they float in water, and the fine ash even remains suspended in the air. Lumps of lava thrown into the air, cooling in oval, twisted masses, are known as volcanic bombs. Gases seem to rise upward with the lava, although some may form by reaction in the craters. Steam rises with the lava, but some of it forms when water flows over the hot lavas. Some of the most violent eruptions known are those near sea level, where it appears probable that water has penetrated fissures to the hot rocks and has been converted into steam. After a period of dormancy a seal forms in the crater, and gases and lavas accumulate, but when the seal is broken by the great pressure of the gases, a violent eruption follows.



There are thousands of volcanic cones, only about 400 of which have been observed in activity. Wherever molten rock rises to the surface, volcanoes may be built up. They may form on mountains or plateaus, on low plains, and on the bottom of the sea. Volcanoes are widely distributed both chronologically and geographically. The great majority of these cones are in or near the sea, <sup>by</sup> far the greatest number being in the mountains and islands which encircle the Pacific Ocean. A volcano in eruption is active. One that has ceased to erupt is dormant. If it is believed that the volcano will not erupt again, it is said to be extinct. It is difficult to distinguish between an extinct volcano and a dormant one, and many volcanoes supposed to be extinct have erupted with great violence.

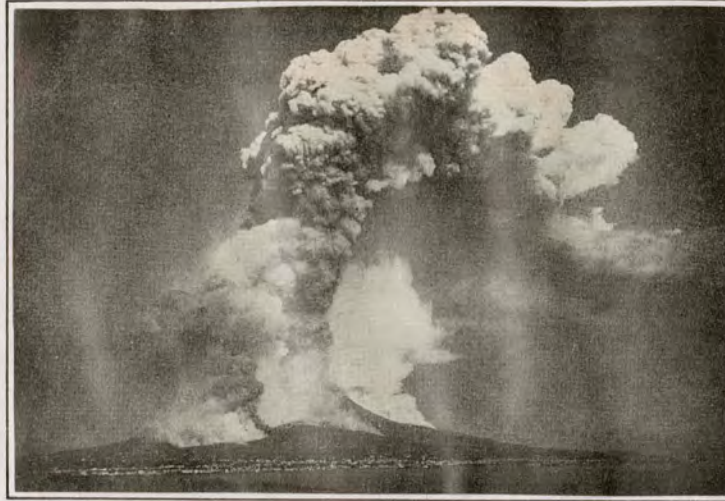
Gas issues from certain volcanoes in large amounts. Steam is by far the most abundant. Some of it is formed by heating ground water and surface water that have come in contact with the hot products of the volcanoes. In some volcanoes, the temperature of the steam has been measured as high as 650° C. Other gases that have been found to issue from volcanoes in usually small amounts are oxygen, nitrogen, argon, carbon dioxide, carbon monoxide, sulphur dioxide, hydrogen sulphide, hydrochloric acid, hydrofluoric acid, ammonia, and sulphuric acid.

There have been many great eruptions, each possessing particular characteristics different from the others. A few of the largest and most famous will be discussed as a generalization of all volcanoes, although the essentials may vary slightly.

Vesuvius, the best known volcano, is situated 7 miles



southeast of Naples in a densely populated region. The height~~s~~ of the mountain varies, but is about 4,000 feet above sea level. (Fig. 3) A great ridge known as Mount Somma half encircles the



Vesuvius in eruption, 1872

present active cone. In 79 A.D. the ancient crater had been quiet so long that trees were growing in it. That year an explosion blew off a large part of the cone of Vesuvius, <sup>burying</sup> three surrounding cities, one being Pompeii. Before the eruption there were frequent earthquakes, one of which partly destroyed Pompeii. Little or no lava was ejected, but much dust, ash, and steam issued, forming a pasty mud that flowed down the slope and overwhelmed dwellings. Pompeii was covered to



Vesuvius and excavated ruins of Pompeii



25 to 50 feet. (Fig. 4) The ashes rose thousands of feet in the air causing the day to be changed into darkness of night and accompanying all this there was fierce thunder and lightning. Gases were exhaled, and these either poisoned or suffocated the citizens. Thousands of people were undoubtedly killed, though there is no record of the number. Since 79 A.D. Vesuvius has had many eruptions, some violent, some moderate, some of ash, and some of lava.

The most violent eruption recorded in historic time is that of Krakatao, a small island between Java and Sumatra. For a century the small island was dormant, but in 1883 an eruption began throwing out pumice and dust, and continued for three days. Nearly all of the island was blown away, and a hole 1,000 feet below sea level was blasted out. Fragments were hurled 17 miles high, and in 15 days the dust from the volcano borne by air currents had encircled the earth. Windows were broken 100 miles from the volcano, and the sound of the explosion was heard more than 150 miles away. Sea waves 100 feet high were generated, and these reaching the shore of neighboring islands destroyed many towns killing about 35,000 people. It appears probable that water has penetrated fissures to the hot rocks and has been converted into steam. The dust from the explosion was carried into the upper atmosphere so as to cause brilliant sunsets for a period of several months, at first near by and about two weeks later entirely around the globe.

Many other great volcanic eruptions have occurred. Those notable of mention are briefly described. During the



eruption of Tambora on Sumbawa Island, Netherlands East Indies, in 1815, rumblings were heard over an area with a radius of about 1,000 miles. Approximately 38 cubic miles of material was thrown out during this eruption, which is the greatest one recorded by man. Mount Etna on the island of Sicily rises to an elevation of about 11,000 feet and covers 460 square miles. Mount Pelée situated on the north end of Martinique, an island of the West Indies, erupted violently in 1902 when hot gas and dust rolled down the mountain side and destroyed Saint Pierre, killing nearly 30,000 people in a few seconds; and only one person escaped death. (Fig. 5) The cloud was so dense that it



Volcanic ash from Mount Pelee

seemed to act like a liquid. Hawaii, the largest of the Hawaiian chain, is built of volcanic matter, which rises<sup>s</sup> high above the level of the sea. Mauna Loa in the southern part of the island has an elevation of about 14,000 feet. It has a crater 2 miles wide and 1,000 feet deep. Other large eruptions have occurred in Japan, Alaska, Siberia, New Zealand, and the Phillipines.

In the formation and evolution of volcanoes, there are three main factors present. First the temperature of the earth's core must be of such intensity that molten rock will



be created. The actual temperature of the interior of the earth is unknown; however, the material ejected from volcanic eruptions possess temperatures ranging from  $1000^{\circ}$  to  $2000^{\circ}$  C., thereby indicating the inner temperatures somewhere in excess of this figure. Second, there must be a means provided for the flowing of this material to the earth's surface. This is probably supplied by cracks and fissures in the rock formations. These occurred during periods of mountain growth, for when mountains stop growing, volcanic activity died out. Third, the molten rock must be forced out of the earth. This is done by the pressures created by the steam of percolating water which had found its way down to the molten material. Such are the functions and wonders of a volcano.

#### BIBLIOGRAPHY

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